

REMARKS

The present invention relates to a processing solution for forming a hexavalent chromium free and corrosion resistant conversion film on zinc or zinc alloy plating layers, a hexavalent chromium free and corrosion resistant conversion film and a method for forming the hexavalent chromium free and corrosion resistant conversion film.

The rejection of Claims 11-12, 14-15 and 17 under 35 U.S.C. § 103(a) as unpatentable over U.S. 6,287,704 (Preikschat et al), is respectfully traversed.

As described in the specification beginning at page 1, line 14, it is known to form trivalent chromium-based corrosion resistant conversion films on zinc or zinc alloy-plated materials. One such method is that disclosed in JP 2000-509434, which is in the same patent family as, and thus equivalent in disclosure to, Preikschat et al. Applicants describe the following with regard to Preikschat et al beginning in the specification at page 2, line 11:

[Preikschat et al] discloses a method, which comprises the step of treating the surface of a metal using a plating bath comprising 5 to 100 g/L of trivalent chromium and nitrate residues, an organic acid and/or a metal salt such as a cobalt salt. This method uses, for instance, trivalent chromium in a high concentration and the plating operation is carried out at a high temperature. Therefore, this method is advantageous in that it can form a thick film and ensure good corrosion resistance. However, the method suffers from a problem in that it is difficult to stably form a dense film and that the method cannot ensure the stable corrosion resistance of the resulting film. Moreover, the processing bath contains trivalent chromium in a high concentration and also contains a large amount of an organic acid. This makes the post-treatment of the waste water difficult and results in the formation of a vast quantity of sludge after the processing. Although one can recognize that it is advantageous to use a processing solution free of any hexavalent chromium for ensuring the environmental protection, the method suffers from a serious problem in that it may give a new burden to the environment such that the method generates a vast quantity of waste.

The inferiority of Preikschat et al's method is demonstrated in the comparative data in the specification herein. Comparative Example 3, which is described in the specification in the paragraph bridging pages 16 and 17, is identical to the cobalt-containing example of

Preikschat et al, i.e., Example 3 therein. All the Examples and Comparative Examples were treated according to the processing steps described in the specification beginning at page 17, line 4, and evaluated for general corrosion resistance according to a salt spray test described therein. The results are shown in Table 5 at page 18 of the specification, reproduced below:

Table 5: Results of Salt Spray Test (JIS-Z-2371) for Determining General Corrosion Resistance

Ex. No.	Appearance of Film	Corrosion Resistance (1) (hr.)	Remarks
1	Pale Blue	240	30°C - 60 seconds
2	Pale Blue	300	30°C - 40 seconds
3	Pale Blue	300	30°C - 40 seconds
4	Pale Blue	300	30°C - 40 seconds
5	Pale Blue	300	30°C - 40 seconds
11	Milky White	Not less than 1000	Possessing Topcoat
12	Milky White	Not less than 1000	Possessing Topcoat
13	Milky White	Not less than 1000	Possessing Topcoat
1*	Reddish Green	240	25°C - 30 seconds
2*	Pale Blue	24	30°C - 40 seconds
3*	Purply Reddish Green	72	30°C - 40 seconds

(1) Time (hour) required for the formation of white rust (5% by mass).

*: Comparative Example

As the data show, the corrosion resistance for the cobalt-containing embodiment of Preikschat et al is significantly worse than for the Examples herein.

Various Examples and Comparative Examples were subjected to a further salt spray test, as described in the specification at page 18, line 6. The results are shown in Table 6, at page 19 of the specification, reproduced below:

Table 6: Results obtained in Salt Spray Test for Determination of Corrosion Resistance after Heating

Ex. No.	Appearance of Film	Corrosion Resistance (1) (hr.)	Content of Co (2) (g/L)
6	Pale Blue	24	0.5
7	Pale Blue	240	1
8	Pale Blue	300	2
9	Pale Blue	360	4
10	Pale Blue	360	8
1*	Reddish Green	24	0
3*	Purply Reddish Green	48	1.0

(1) Time (hour) required for the formation of white rust (5% by mass).

(2) The cobalt content in the processing solution.

*: Comparative Example

Compare the results for Example 7 and Comparative Example 3, each of which has the same cobalt content. The corrosion resistance of Comparative Example 3, i.e., Preikschat et al, is significantly less than that of Example 7. Finally, see the data in Table 7 at page 19 of the specification, reproduced below:

Table 7: Contents of Zinc, Chromium, Cobalt and Oxalic Acid and Thickness of Films

Ex. No.	Zn Content (mg/dm ²)	Cr/(Cr+Zn) (mass ratio)	Co/(Cr+Co) (mass ratio)	C ₂ O ₄ /(C ₂ O ₄ +Cr) (mass ratio)	Film Thickness (μm)
6	1.50	25/100	5.7/100	9.1/100	0.07
7	1.50	25/100	12.3/100	19.4/100	0.08
8	1.50	25/100	20.6/100	28.6/100	0.08
9	1.50	23/100	30.8/100	43.0/100	0.09
10	1.50	21/100	36.5/100	46.7/100	0.09
1*	4.30	39/100	0.0/100	0.0/100	0.30
3*	2.20	31/100	2.9/100	0.0/100	0.10

*: Comparative Example

Note that the thickness of Preikschat et al's film is greater than that of the examples, yet in general, provides inferior corrosion resistance.

The disclosure in Preikschat et al is considerably broader than the presently-claimed invention. For example, while the present invention requires cobalt, it is optional in Preikschat et al. In addition, many metals other than cobalt may be included (column 5, lines 20-26). Note, however, that Preikschat et al neither discloses nor suggests a way for further increasing the cobalt concentration of their conversion film. In addition, while Preikschat et al discloses that their chromium (III) complex preferably has chelate ligands which are selected from a large group of compounds which are inclusive of dicarboxylic acids, including, *inter alia*, oxalic acid (column 6, lines 1-21), the present invention requires oxalic acid. Preikschat et al neither discloses nor suggests that the presence of oxalic acid allows the cobalt concentration in the conversion film to increase by forming a salt with cobalt in the conversion film.

Nor obviously could one skilled in the art have predicted the above discussed comparative results with regard to Preikschat et al.

For all the above reasons, it is respectfully requested that the rejection over Preikschat et al be withdrawn.

The rejection of Claims 11-17 under 35 U.S.C. § 103(a) as unpatentable over U.S. 4,349,392 (Huvar), is respectfully traversed. Huvar discloses an aqueous acidic solution and process for treating metal surfaces, particularly zinc and zinc alloy surfaces, for depositing a passivate film of improved clarity and hardness and to impart improved corrosion resistance thereto, wherein the solution contains effective amounts of chromium ions substantially all of which are in the trivalent state, hydrogen ions to provide a pH of about 1.2 to about 2.5, an oxidizing agent, a bath soluble and compatible organic carboxylic acid or metal salts thereof present in an amount to impart increased initial hardness and improved clarity to the passivate film and at least one additional metal ion selected from the group consisting of iron, cobalt, nickel, molybdenum, manganese, lanthanum, cerium, lanthanide mixtures as well as mixtures

thereof, and the treating solution may optionally further contain halide ions and a wetting agent (Abstract). The Examiner finds that the organic carboxylic acid of Huvar is inclusive of oxalic acid. It is not. The structural formula at column 2, line 12ff excludes oxalic acid, which has the formula HOOC-COOH. Nor obviously could one skilled in the art have predicted the results obtained from the combination of oxalic acid and cobalt, wherein the oxalic acid allows the cobalt concentration in the conversion film to increase by forming a salt with cobalt in the conversion film. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 18-26 under 35 U.S.C. § 103(a) as unpatentable over Preikschat et al or Huvar, in view of the ASM Handbook (ASM Handbook), is respectfully traversed. ASM Handbook does not remedy any of the above-discussed deficiencies in Preikschat et al and Huvar. Accordingly, it is respectfully requested that this rejection be withdrawn.

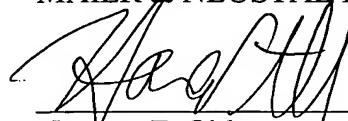
The provisional rejection of Claims 11-26 over Claims 13-29 of copending application number 10/085,705 (copending application), is respectfully traversed. **Submitted herewith** is a terminal disclaimer over the copending application. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 11-26 under 35 U.S.C. § 112, second paragraph, is respectfully traversed. Indeed, the rejection is now moot in view of the above-discussed amendment, and the reasons given therein. Accordingly, it is respectfully requested that this rejection be withdrawn.

All of the presently pending and active claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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